CITY OF LODI
PUBLIC WORKS DEPARTMENT

COUNCIL COMMUNICATION

AGENDA TITLE: Mokelumne River Water Quality Monitoring Study

MEETING DATE: June 19, 1991

PREPARED BY: Public Works Director

RECOMMENDED ACTION: That the City Council accept the enclosed Final Report on Monitoring of the Mokelumne River and approve future monitoring as described below.

BACKGROUND INFORMATION: The Mokelumne River is one of three major sources of recharge to Lodi's groundwater system, therefore it's water quality is of interest to the City. The City Council requested a study to determine what water quality monitoring of the Mokelumne River would be beneficial. In September 1990 Brown and Caldwell Consulting Engineers were retained to do a monitoring study.

The enclosed final report summarizes water quality in the Mokelumne River from existing East Bay Municipal Utility District (EBMUD) and a U.S Geological Survey (USGS) data. The conclusion of this study is that there is "no apparent ne-d to monitor the Mokelumne River... with the possible exception of trihalomethane formation potential (THMFP)".

The Public Works Department would therefore recommend that we collect future monitoring data from existing EBMUD and USGS sources. We would also recommend that we conduct only two rounds of THMFP monitoring and then evaluate the results to determine if more should be done.

FUNDING: The cost is $200 per THMFP analysis and it would be charged to the water production testing account, 18-453.01-399.

Jack L. Ronsko

JLR/FB/ts

Prepared by Frank Beeler, Assistant Water/Wastewater superintendent

cc: Water/Wastewater Superintendent

APPROVED: Thos. A. Peterson
THOMAS A. PETERSON, City Manager

FILE NO.

0691WB.01

June 12, 1991

Brown and Caldwell
Consultants

723 S Street
Sacramento
California 95814-7092
(916) 444-0123
FAX (916) 444-8437

April 29, 1991

Mr. Frank Beeler
Assistant Water/Wastewater Superintendent
City of Lodi
221 West Pine Street
Lodi, California 95241

017-5517-05

Subject: **Final Report on Monitoring of the Mokelumne River**

Dear Mr. Beeler:

The water quality of the Mokelumne River is of interest to the City of Lodi (City) because it is one of three sources of recharge to the Lodi groundwater system. The other two sources are percolating water (rainfall and applied irrigation water) and deep regional recharge from the groundwater system upgradient of Lodi. The City contracted with Brown and Caldwell Consultants to develop a sampling plan for the Mokelumne River. The purpose of the sampling was to gather data on constituents of drinking water concern and enable the City to assess any current or potential harmful effects of the Mokelumne River recharge on Lodi's groundwater system.

The major components of a sampling plan are (1) the constituents to be sampled, (2) the sampling location(s), (3) the sampling schedule, and (4) sampling procedures. To develop a list of constituents to be sampled, research was done on existing water quality data and on the contribution of pollutants into the Mokelumne River upstream of Lodi. The results of the research show that, in our judgment, the City has no apparent need to monitor the Mokelurnne River for any of the constituents researched with the possible exception of trihalomethane formation potential (THMFP) (for which there were no data available for the Mokelumne River in the vicinity of Lodi).

We recommend instead, that the City collect data from the existing United States Geological Survey (USGS) and East Bay Municipal Utility District (EBMUD) monitoring programs. The City can thus track any significant future changes in Mokelumne River water quality at little cost. EBMUD also monitors the Mokelumne River at Pardee Reservoir (including THMFP) and we recommend this data also be collected. The USGS data can be obtained from Mr. Steve Anderson at (916) 978-4658. There is a fee for this data. The EBMUD data was obtained from Mr. Hubert Lai at (415) 287-1138.

We recommend the City institute limited monitoring for THMFP in the Lodi reach of the Mokelumne River for a one-year period to establish general levels before determining that any long-range monitoring of THMFP is necessary.

This report discusses the research that led to these recommendations. Monitoring locations, schedule, and sample collection procedures for the recommended limited THMFP monitoring are also discussed.

RESEARCH

The research focused on those aspects of flow, water quality, and discharges to the Mokelumne River which may impact the drinking water quality of water recharging the City of Lodi's (City) groundwater aquifer. The rate at which water moves in a river system is orders of magnitude greater than the rate at which water moves in a groundwater system. Therefore, it is the average-long-term water quality of the river which will affect the water quality of the groundwater system. Pollutants from an acute event: (which releases high concentrations of a pollutant for a short period of time) move downstream quickly relative to the rate at which river water recharges the groundwater system. Acute events are not of concern to the quality of Lodi's groundwater and were not part of this research-

Research Sources

The research has included:

1. Discussions with Central Valley Regional Water Quality Control Board (Regional Board) staff in the San Joaquin, Amador and Calaveras Counties Regulatory Sections on their knowledge of discharges to the Mokelumne River upstream of Lodi.

2. Discussions with EBMUD staff on their monitoring of the Mokelumne River. EBMUD monitors monthly at Pardee Reservoir and also monitors on a less regular basis a Camanche Reservoir where the water enters the Lower Mokelumne River. Water quality data was obtained for EBMUD monitoring stations at Camanche Reservoir. EBMUD has also done some work on flow in the Lower Mokelumne River between Camanche Reservoir and Woodbridge Irrigation District Canal.

3. Water quality data was obtained from the USGS for their monitoring station on the Mokelumne River at Woodbridge. The USGS monitors on a mostly monthly basis. Flow data was also obtained from the USGS from their monitoring stations on the Mokelumne River below Camanche Reservoir and at Woodbridge and at the Woodbridge Canal.

4. City water quality data was obtained for Well 7, the City well closest to the Mokelumne River.

5. A review of the Regional Board's file on Penn Mine and discussions with Steven Bond, the Regional Board staff member assigned to the Penn Mine.

6. A review of the Regional Board's 1988-1989 Beneficial Use Assessment Report.

7. Discussions with staff of the Lodi Office of the San Joaquin County Agricultural Commissioner on agricultural practices, particularly chemical applications to cultivated land along the Mokelumne River between Camanche Reservoir and Woodbridge.

8. A review of the National Pollutant Discharge Elimination System Permit for the Mokelumne River Fish Hatchery.

9. Department of Water Resources, Central District, land use records for the area along the Mokelumne River between Camanche Reservoir and Woodbridge.

10. A reconnaissance of the Mokelumne River area between Camanche Reservoir and Woodbridge.

Flow Dab

Flow in the Lower Mokelumne River at Lodi depends on the amount of rainfall in a particular year, EBMUD releases from Camanche Reservoir, natural losses to groundwater (channel losses), evaporation, and uptake by riparian vegetation, and to some extent, agricultural diversion and return flow. Flow in the Lower Mokelumne River over the last 10 years has ranged from 172 cubic feet per second (cfs) in 1988 to 2,400 cfs in 1983 below Camanche Reservoir. At Lodi, flow for these two years ranged from 109 cfs in 1988 to 2,252 cfs in 1983. EBMUD estimates channel losses between Camanche Reservoir and Woodbridge in 1988 averaged about 60 to 70 cfs. When Lodi Lake is filled, the contribution of the lake's wetted surface area increases to some degree the channel loss (recharge to groundwater) at this time. Well 7, which is the closest City well to the Mokelumne River and is close to Lodi Lake, is probably more directly impacted by the quality of Mokelumne River water than other City wells.

Upstream Discharges to the Mokelumne River

There are three types of major discharges to the Mokelumne River above and in the vicinity of Lodi. These are discharges from Penn Mine, from agricultural use of the land between Camanche Reservoir and Lodi, and from urban runoff from the City. These sources and the types of constituents they may discharge to the Mokelumne River are shown on Table 1. Also shown on Table 1 is a column indicating whether the constituents are of concern to drinking water use. Not all pollutants are of concern to drinking water use. Aquatic life is in general

Table 1. Discharges to the Mokelumne River

Discharge source	Constituent	Regulated drinking water constituent
Penn Mine	Aluminum Copper Iron Lead Zinc	Aluminum Copper Iron Lead Zinc
Agricultural return flows	Dissolved solids Numents Pathogens Organic matter Sulfur	Dissolved solids Nitrate Coliform Trihalomethanes[a] Sulfate
Urban runoff	Copper Lead Zinc Hydrocarbons Fecal coliform bacteria Arsenic Cadmium Chromium Nickel	Copper Lead Zinc Various hydrocarbon constituents[b] Fecal coliform bacteria Arsenic Cadmium Chromium Nickel

[a]Formed when water high in organic carbon is chlorinated.
[b]Includes benzene, ethylbenzene, toluene, and xylene.

more susceptible to a wider range of constituents than human consumption. For example, the well-publicized Mokelumne River fish kills have been attributed variously to dissolved oxygen content, hydrogen sulfide, pH, turbidity, temperature, and toxicity (metals). Of these, only metals is of concern to drinking water taken from groundwater. The metals concentrations that are harmful to aquatic life are much lower than drinking water standards. Turbidity is a major problem for surface water sources.

Penn Mine discharges metals into Camanche Reservoir, mostly in the wet season. The volume is variable and not quantified. When the acidic discharge water from Penn Mine is diluted by the waters of Camanche Reservoir, the pH is raised and metals precipitate. In addition, metals send to adsorb onto particulate matter. A proportion of these precipitated and adsorbed metals will settle and become entrained in the sediments at the bottom of Camanche Reservoir. During the fall when the lake level is low and the temperature is warm, the thermally stratified water layers of the lake mix. When the lowest layer of reservoir water mixes with the upper layers sediments with adsorbed metals, from the bottom of the reservoir are mixed back into the reservoir water. This seasonal fall overturn and attendant increased metals concentrations in Camanche Reservoir generally lasts less than a month. Camanche Reservoir is listed as an impaired water body by the Regional Board due to metals from Penn Mine.

The major crop grown along the Mokelumne River between Camanche Reservoir and Woodbridge is wine grapes (and, to a lesser degree, walnuts). The most commonly used chemical on grapes since the banning of dibromochloropropane (DBCP) in 1977 is sulfur, which is applied primarily in the spring for mildew control. No equivalent of DBCP has been developed for nematode control. Other chemicals which are applied episodically on an as-needed basis include Round-Up (glyphosate), paraquat, and furadan. The use of sulfur, however, is the predominant chemical application. On walnut orchards, the common chemical application involves a dormant spray in winter which is usually mineral oil, but may also be sulfur or copper based compounds.

Discharges of urban runoff from the City of Lodi primarily occur in the wet season and probably (based on urban runoff studies in Sacramento and Fresno) contain some metals, coliform bacteria, and oil and grease. The impact of U.S. Environmental Protection Agency (EPA) regulations, effective in December 1990, which require stormwater discharges (urban runoff) to be permitted under the Natural Pollutant Discharge Elimination System on the City of Lodi are not certain. Currently, municipalities with a population greater than 100,000 are subject to the new regulations.

Other less important discharges to the Mokelumne River come from abandoned mines upstream of Camanche Reservoir (Pardee Reservoir is listed as impaired by mercury, which may come from the former treatment of gold ores), powerhouses on the North Fork of the Mokelumne River which may at times contribute oil and grease, the Mokelumne River Fish Hatchery, the Lockeford Wastewater Treatment Plant, backwash water from the Calaveras Public Utility District Water Treatment Plant, and gravel mining which may contribute some oil and grease from the equipment used. These discharges are minor compared to the three major discharges discussed above, Their impact on the recharge water quality of Mokelumne River to the groundwater system in the Lodi area is probably insignificant. No industrial waste water discharges to the Mokelumne River were identified.

Water Quality in the Lower Mokelumne River

Table 2 shows water quality data for the Mokelumne River at Camanche Reservoir and Woodbridge and for City Well 7. The data shown are for those constituents listed on Table 1 which are likely to be discharged to the Mokelumne River upstream of Lodi and which are of drinking water concern. Mercury is also shown due to the impairment of the Mokelumne River at Pardee Reservoir by mercury. In the event regulations require the City to chlorinate their groundwater, trihalomethane (THM) formation would become of interest to the City. Therefore, THMs are also shown on Table 2. Table 2 also shows the drinking water standards for these constituents and which of these constituents migrate easily from surface water through the channel bottom to the groundwater aquifer.

The quality of the Mokelumne River with *regard* to these constituents is excellent for drinking water. All maximum concentrations detected (with the exception of coliform bacteria) are well below the drinking water standard for each constituent. No data were available for hydrocarbons or THMFP at these monitoring stations. THMFP is the test of the capacity of a water source to form THMs upon chlorination. The mean THMFP concentration at the EBMUD Mokelumne River at Pardee Reservoir for 1953 and 1984 was about 0.25 milligrams per liter (mg/l). The current California drinking water standard for THMs is 0.01 mg/l. The method used to determine THMFP yields results indicative of the maximum amount of THMs that could be produced in a raw water source. Actual THM concentrations in treated water are generally much lower than THMFP concentrations for a number of reasons including actual lower chlorine dosages and shorter reaction times.

There are no data on hydrocarbon concentrations. Coliform bacteria in the Mokelumne River exceed finished drinking water standards. However, neither of these constituents is of concern as they will tend not to migrate from a surface stream to groundwater. Hydrocarbons which are released into the soil above the groundwater system, such as pure gasoline at an underground storage tank leak site, will leach readily through soil to groundwater. Hydrocarbons in a stream, however, will be carried on or near the surface of the water and will rapidly move downstream.

Chemicals applied episodically to wine grape crops [Round-up (glyphosate), paraquat, and furadan] which may enter the Mokelumne River in agricultural return flow discharges are not considered threats to Lodi' groundwater quality because of the limited, irregular pattern of use. Of these three chemicals, furadan would be the most likely to migrate from the river water to groundwater. Glyphosate and paraquat would tend not to migrate from river water to groundwater.

Table 2. Water Quality

Constituent	Mokelumne River[a] at Camanche Dam		Mokelumne River[b] at Woodbridge, 1980-1990		Well 7[c]		Drinking water standards	Ability to migrate to groundwater
	Mean	Range	Mean	Range	Mean	Range		
Dissolved solids, mg/l	N.A.[d]	N.A.	35	22-70	130	108-152	500[e]	Dissolved ionic salts will migrate easily
Nitrate as N, dissolved, mg/l	N.A.	NA.	<0.1	<0.1-0.22	<1 (as No_3)	<1-3 (as No_3)	10[f]	Migrates easily
Sulfate mg/l	2.2	pr-2.a	3.0	0.7-9.7	2	<2-7	400/500[f,h]	Migrates easily
Coliform, fecal (cols./100 ml)	N.A.	N.A.	110	32-490	N.A.	N.A.	1[f]	Will tend not to migrate
Hydrocarbons	N.A.	NA.	N.A.	N.A.	N.A.	N.A.	Various[f]	Will tend not to migrate
Trihalomethanes, total mg/l	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.10[f,i]	THM precursors such as smaller organic carbons will migrate easily. Larger compounds such as humic acids will tend not to migrate.
Aluminum, dissolved, µg/l	<10	<10-60	20	<10-40	<50	-[g]	1000[f]	Will tend not to migrate unless water is acidic
Arsenic, dissolved, µg/l	N.A.	N.A.	0.5	<1-2	<4	<4-5	50[f]	Will tend not to migrate unless water is aadic
Cadmium, dissolved, µg/l	<2	<2-1	<0.1	<0.1-2	<0.1-	-[g]	10[f]	Migrates slowly
Copper, dissolved, µg/l	2	Q-12	2	<1-8	<20	-[g]	1300[f]	Migrates slowly
Chromium, dissolved, µg/l	<5	-[d]	<1	<1-10	<10	-[g]	50[f]	Will migrate slowly only through sandy soils

Table 2. Water Quality (*Continued*)

Constituent	Mokelumne River[a] at Camanche Dam		Mokelumne River[b] at Woodbridge, 1980-1990		Well 7[c]		Drinking water standards	Ability to migrate to groundwater
	Mean	Range	Mean	Range	Mean	Range		
Iron, dissolved, µg/l	<20	<20-380	40	14-170	<30	<30-120	300[e]	Will tend not to migrate unless water is acidic
Lead, dissolved, µg/l	<30	<30-30	1	<1-10	<1	<1-2	50[f]	Will migrate slowly only through sandy soils
Mercury, dissolved, µg/l	N.A.	N.A.	<0.1	<0.1-0.9	<0.2	-[g]	2[f]	Will tend not to migrate unless water is acidic
Nickel, dissolved, µg/l	<10	<10-20	<1	<1-3	<4	<4-5	100[f]	Migrates slowly
Zinc, dissolved, µg/l	3	<3-5.9	9	5-30	<10	-[g]	5000[e]	Migrates slowly

[a]EBMUD Data - Period of record = 1989 and 1990.
[b]USGS Data - Period of record = 1980 through 1990.
[c]City of Lodi Data - Period of record = 1970 through 1990.
[d]N. A. = not analyzed.
[e]Federal or State secondary drinking water standard.
[f]Federal or State primary drinking water standard.
[g]Indicates all samples were non-detectable.
[h]Federal primary drinking water standard currently being promulgated.
[i]The current federal primary drinking water standard is scheduled to be reviewed and will probably be lowered by 1991.

From the available data, no trends from upstream to downstream were observable. Seasonal trends that were observed are that (1) the mean total dissolved solids (TDS) concentrations for the last three dry years is 45 mg/l, which is higher than the longer term mean concentration, and (2) coliform concentrations at Woodbridge are generally higher in wet months than in dry months.

The water quality of Well 7 is also excellent. In general, lower concentrations of these constituents are found in water from Well 7 than in the Mokelumne River and probably reflects the filtering effect of the sediments between the Mokelumne River and the screened interval of the well. An exception to this is that TDS concentrations are higher in Well 7 than in the River. TDS concentrations in Well 7, however are very good for groundwater, and generally lower than other City wells. Well 7 appears to be among the best producers with respect to water quality of any of the City wells.

LIMITED THMFP MONITORING

Monitoring locations, monitoring schedule, and sample collection procedures for THMFP are discussed below.

Monitoring Locations

Two suitable monitoring locations which would "bracket" the quality of water in the Lodi reach of the Mukelumne River are the Bruella Road bridge and the Lower Sacramento Road bridge. Both bridges have sufficient space and safety for a pedestrian to collect river samples with a bucket tied to a rope and lowered to the river either manually or with the aid of a pulley affixed to the bridge railing. The bucket is allowed to fill with river water and then raised back up to the bridge. The bucket should be cleaned and rinsed with deionized water before collecting the river sample. Collecting a river sample from a bridge enables the samole collector to collect a well-mixed sample from mid-stream.

Monitoring Sch. :ule

We recommend sampling for THMFP quarterly for a one-year period. This should provide a fairly average THMFP concentration in the Mokelumne River during this period in a cost-effective way.

Sample Collection Procedures

The river sample collected in the bucket should be poured into eight 250-milliliter amber bottles with teflon seals. There should be no head space in the sample bottle. The samples should be stored at 4°C in the dark and must be analyzed within 14 days of collection. The analytical method is EPA Method 510.1

If you have any questions regarding the above information or recommendations, please contact me at (926) 444-0123.

Very truly yours,

BROWN AND CALDWELL

Jeanne Wallberg

Jeanne Wallberg
Project Manager

JSW:mkw